Surgical Reconstruction of Defects of the Jaws

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CHAPTER

CHATTER OUTLINE

Defects of the facial bones, especially the jaws, have a variety of causes, such as eradication of pathologic conditions, trauma, infections, and congenital deformities. The size of the defects that are commonly reconstructed in the oral and maxillofacial region varies considerably from small alveolar clefts lo mandibulectomy defects. Each defect poses a unique set of problems that reconstructive surgical intervention must address, fn each of these instances restoration of normal structure is usually possible, with resultant improvement in function and appearance.

When an osseous structure is defective either in size, shape, position, or amount, reconstructive surgery can replace the defective structure. The tissue most commonly used to replace lost osseous tissue is bone. Bone grafting has been attempted for centuries with varying degrees of success. Recent advancements in the understanding of bone physiology, immunologic concepts, tissue-banking procedures, and surgical principles have made possible the successful reconstruction of most maxillofacial bony defects. As such, the biology and principles of transplantation of bone are presented in this chapter.

BIOLOGIC BASIS OF BONE RECONSTRUCTION

A tissue that is transplanted and expected to become a part of the host to which it is transplanted is known as a *graft*. Several types of grafts are available to the surgeon,

which are discussed later. A basic understanding of how a bone heals when grafted from one place to another *in the same individual* (i.e., autotransplantation) is necessary to understand the benefits of the various types of bone grafts available.

The healing of bone and hone grafts is unique among connective tissues, because new bone formation arises from tissue regeneration rather than from simple tissue repair witli scar formation.[1] This healing therefore requires both the clement of cellular proliferation (i.e., osteoblasts] and the element of collagen synthesis. When bone is transplanted from one area of the body to another, several processes become active during the incorporation of the graft.

Two-Phase Theory of Osteogenesis

Two liasic processes occur on transplanting bone from one area to another in the .same individual[12]-[5]: The first process that leads to bone regeneration arises initially from transplanted cells in the graft that proliferate and form new osteoid. The amount of bone regeneration during this phase depends on the amount of transplanted bone cells that survive the grafting procedure. Obviously, when the graft is first removed from the body, the blood supply has been severed. Thus the cells in the bone graft depend *on* diffusion of nutrients from the surrounding graft bed (i.e., the area where the graft is placed) for survival, A considerable amount of cell death occurs during the grafting procedure, and this first phase of bone regeneration may not lead to an impressive amount of bone regeneration when considered alone. Still, this phase is responsible for the formation of most of the new bone. The more viable cclis that can be successfully transplanted with the graft, the more bone that will form.

The graft bed also undergoes changes that lead to a second phase of bone regeneration beginning in the second week. Intense angiogenesis and fibroblastic proliferation from the graft bed begin after grafting, and osteogenesis from host connective tissues soon begins. Fibroblasts and other mesenchymal cells differentiate into osteoblasts and begin to lay down new bone. Evidence shows that a protein (or proteins) found in the bone induces these reactions in the surrounding soft tissues of the graft bed.[6,7] This second phase is also responsible for the orderly incorporation of the graft into the host bed with continued resorption, replacement, and remodeling.

Immune Response

When a tissue is transplanted from one .site So another in the same individual, immunologic complications usually do not occur. The immune system is not triggered, because the tissue is recognized as "self," However, when a tissue is transplanted from one individual to another or from one species to another, the immune system may present a formidable obstacle to the success of the grafting procedure. If the graft is recognized as a foreign substance by the host, it will mount an intense response in an attempt to destroy the graft. The type of response the immune system mounts against "foreign" grafts is primarily a cell-mediated response by T-lymphocytes. 11 may not occur immediately., however, and in the early period the incorporation of a bone graft into the host may appear to be progressing normally. The length of this latent period depends on the similarity between the host and the recipient. The more similar they are (antigenically), the longer an immunologic reaction may take to appear. This type of immunologic reaction is the most common reason for rejection of hearts, kidneys, and other organs transplanted to another individual. Tissue-typing procedures, in which a donor and recipient are genetically compared for similarities before transplantation, are currently commonplace for organ transplantation but never for bone grafts.

Because of the immunologic rejection of transplants between individuals or between species, methods have been devised to improve the success of grafting procedures in these instances. Two basic approaches are used clinically: The first is the suppression of the host individual's immune response. Immunosuppression with various medications is most commonly used in organ transplant patients. This approach is not used routinely in oral and maxillofacial surgical bone grafting procedures because of the potential complications from immunosuppression.

Another approach that has been used extensively in oral and maxillofacial surgical procedures is the alteration of the antigenicity of the graft so that the host's immune response will not be stimulated. Several methods of treating grafts have been used, including boiling, deproteinizing, merthiolating, freezing, freeze-drying, irradiating, and dry heating. All of these methods, potentially helpful for use in bout[5] grafts, are obviously not helpful in organ transplants.

TYPES OF GRAFTS

Several types of bone grafts are available for use in reconstructive surgery. A useful classification categorizes the bone grafts according to their origin and thus their potential to induce an immunologic response. Because of their origins and the preparations used to help avoid an intense immune response, the grafts have different qualities and indications for use.

Autogenous Grafts

Also known as *antografts* or *self-grafts,* autogenous grafts are composed of tissues from the same individual. Fresh autogenous bone is the most ideal bone graft material. It is unique among bone grafts in that it is the only type of bone graft to supply living, immunocompatible bone cells cssentiai to phase I osteogenesis. The larger number of living cells that are transplanted, the more osseous tissue thai will be produced.

Autogenous bone is the type used most frequently in oral and maxillofacial surgery. It can be obtained from a host of sites in the body and can be taken in several forms. Block grafts *are* solid pieces of both cortical bone and underlying cancellous bone (Fig, 28-1). The iliac crest is often used as a source for this type of graft. The entire thickness of the ilium can be obtained, or the ilium can be split to obtain a thinner piece of block graft. Ribs also constitute

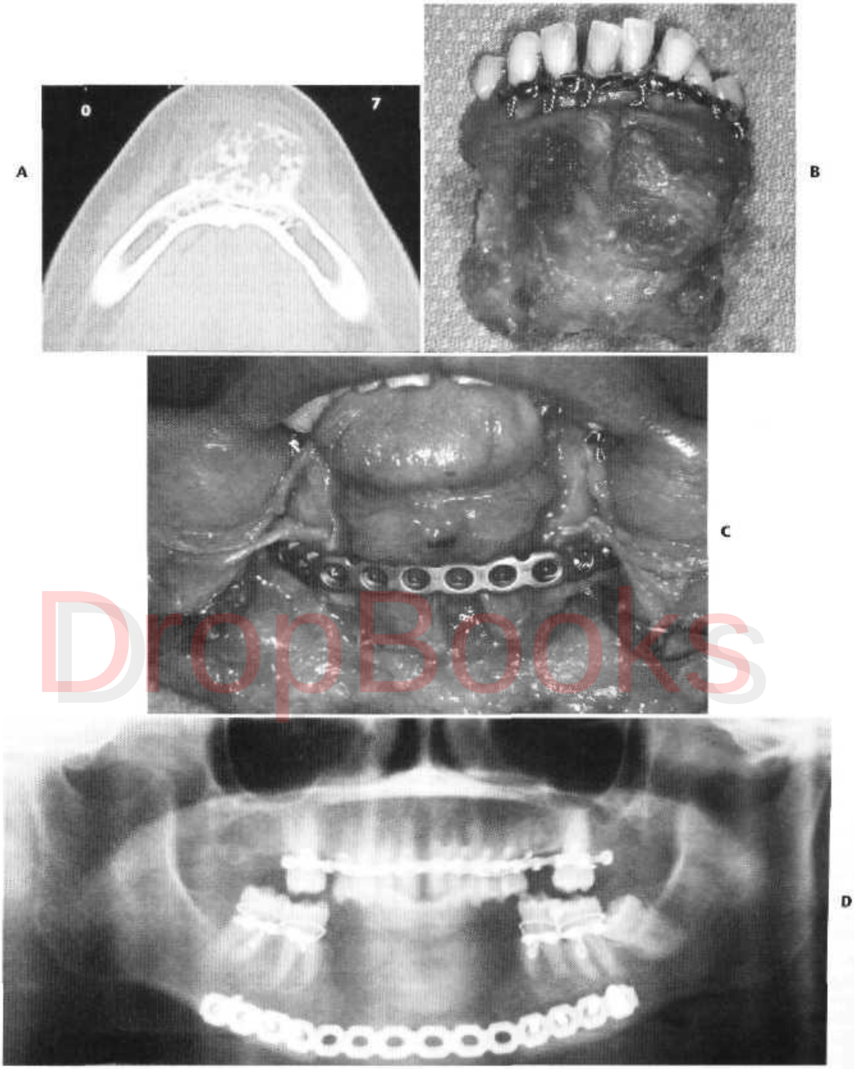

FIG. 28-1 The use of autogenous block cortic oca n cellos-bone graft to replace defect in mandibular symphysis. This patient had an ameloblastoma Of Lhe anterior mandible. A, Computed tomography (CT) scan showing expansion and irregularity of bone. B, Specimen thai wai resected using an intraoral approach. *C,* Bone plate used to span the resection gap, controlling the position of the right and left mandibultir halves and allowing the patient to function postoperatively without the need (or maxillomandibular fixation. D, Panoramic radiograph taken immediately after resection. Three months later the oral soft tissues have healed and the patient is prepared for bone graft reconstruction of the symphysis.

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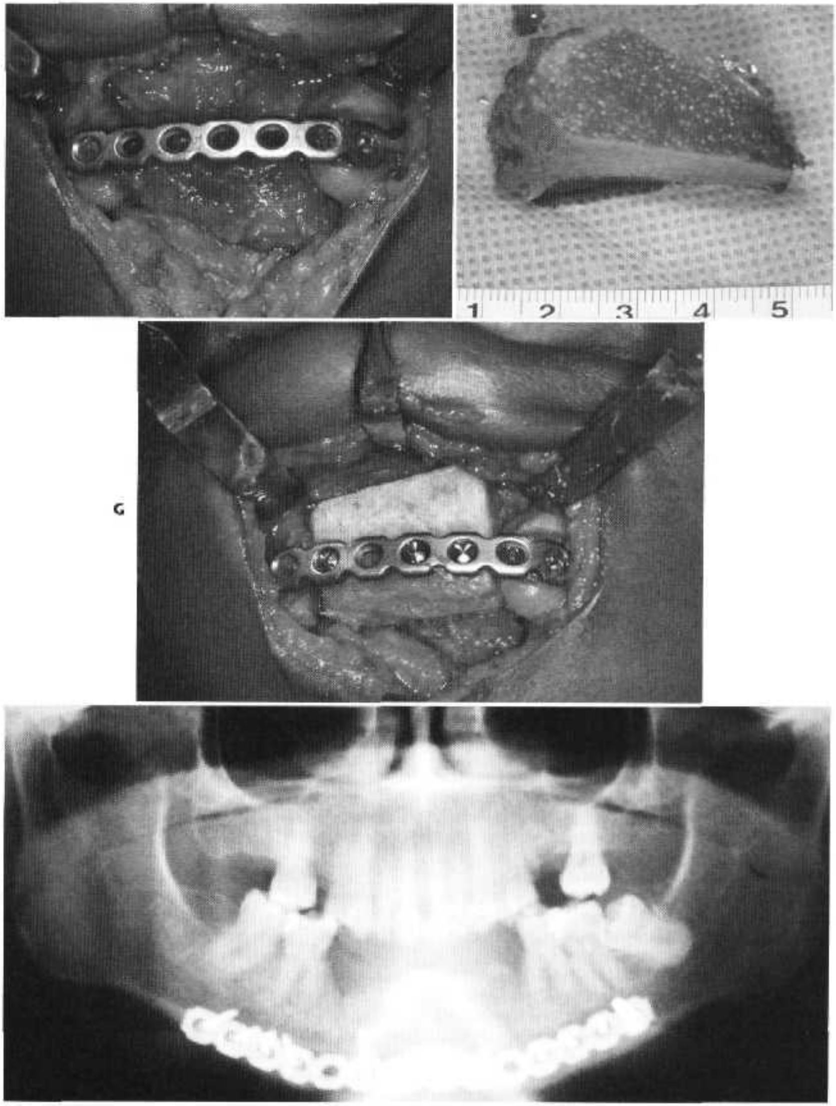

FIG. 28-1—cont'd E, Surgical exposure using an extraoral approach. F, Full-thickness bone graft harvested Irom the ilium along with participate marrow and cancellous bone to use as "filler" and to provide osteocompetent cells. G, Bpne graft attached to the bone plate, ^articulate bone is then packed around the area to promote bone healing. H, Panoramic radiograph taken 6 months later showing bone fill and healing of graft to both mandibulcir halves.

a form of block graft. Paniculate marrow and cancellous-bone grafts are obtained by harvesting the medullary bone and the associated endosteum and hematopoietic marrow. Particulars marrow and cancellous-bone grafts produce the greatest concentration of osteogenic cells, and, because *oi* the paniculate nature, more cells survive transplantation because of the access they have to nutrients in the surrounding graft bed. The most common site for the procurement of this type of graft is the ilium. The iliac crest can be entered, and large volumes of particulars marrow and cancellous-bone grafts can be obtained with large curettes, The diploic spate of the cranial vault has recently been used as a site for obtaining this type of graft when small amounts of bone chips are needed (e.g., alveolar cleft grafts).

Autogenous bone may also be transplanted while maintaining the blood supply to the graft. Two methods can accomplish this: The first involves the transfer of a bone graft pedicled to a muscular (or muscular and skin) pedicle. The bone is not stripped of its soft tissue pedicle, preserving some bLood supply to the bone graft. Thus the amount of surviving osteogenic cells is potentially great. An examtile of this type of autogenous graft is a segment of the clavicle transferred to the mandible, pedicled to the stcrnocleidomastold muscle. The second method by which autogenous bone can be transplanted without losing blood supply is by the useof microsurglcal techniques. A block oi ilium, tibia, rib, or other suitable bone is removed along with the overlying soft tissues after dissecting free an artery and a vein that supply the tissue, An artery and a vein are also prepared in the recipient bed. Once the bone graft is secured in place, the artery and veins are reconnected using micTovascuIar anastomoses. In this way the blood supply to the bone graft is restored.

Both of these types of autogenous grafts are known as *composite grafts,* because they contain both soft tissue and osseous elements. The first type described, in which the bone maintains a muscular origin, is a pedicled composite graft. The pedicle is the soft tissue remaining on it, which supplies the vasculature. The second type of composite graft is a tree composite graft, meaning that it is totally removed from the body and immediately replaced, and its blood supply is restored by reconnect ion of blood vessels.

Although these types of grafts may seem ideal, they have some shortcomings when used to restore defects of the jaws. Because the soft tissues attached to the bone graft maintain the blood supply, there can be minimal stripping of the soft tissue from the graft during procurement and placement. Thus the size and shape of the graft cannot be altered to any significant degree. Frequently, inadequate bulk of bone is provided when these grafts arc used to restore mandibular continuity defects. Another problem is the morbidity to the donor site. Instead of just removing osseous tissue, soft tissues are also removed with composite grafts, which causes greater functional and cosmetic defects.

Advantages, The advantages of autogenous bone arc that it provides osteogenic cells for phase I bone formation, and no unmunologic response occurs.

Disadvantages. A disadvantage is that this procedure necessitates another site of operation for procurement of graft.

Allogeneic Grafts

Also known as *allagrafis* or *hotnografts,* allogeneic grafts arc grafts taken from another individual of the same species. Because the individuals are usually genetically dissimilar, treating the graft to reduce the antigenicity is routinely accomplished. Today the most commonly used allogeneic bone is freeze-dried. All of these treatments destroy any remaining osteogenic cells in the graft, and therefore allogeneic bone grafts cannot participate in phase I osteogenesis. The assistance of these grafts to osteogenesis is purely passive; they offer a hard tissue matrix for phase II induction.

Thus the host must produce all of the essential elements in the graft bed for the allogeneic bone graft to become resorbed and replaced. Obviously, the health of the graft bed is much more important in this set of circumstances than it is if autogenous bone were to be used.

Advantages, Advantages are that allogeneic grafts do not require another site of operation in the host and that a similar bone or a bone of similar shape to that being replaced can be obtained (e.g., an allogeneic mandible can be used for reconstruction of a mandibulcctomy defect).

Disadvantages. The disadvantage is that an allogeneic graft does not provide viable cells for phase 1 ostcogenesis.

Xenogeneic Grafts

Also known as *xenografts* or *hetewgrafts,* xenogeneic grafts are taken from one species and grafted to another. The antigenic dissimilarity of these grafts is greater than with allogeneic bone. The organic matrix of xenogenic bone is antigcnically dissimilar to that of human bone, and therefore the graft must be treated more vigorously to prevent rapid rejection of the graft. Bone grafts of this variety are rarely used in oral and maxillofacial surgery.

*Advantage**,* Advantages are that xenografts do not require another site of operation in the host, and a large quantity of bone can be obtained.

Disadvantages. Disadvantages are that xenografts do not provide viable cells for phase 1 osteogenesis and must be rigorously treated to reduce antlgenicity.

Combinations of Grafts

The ideal graft would have the structural characteristics of a block graft with the osteogenic potential of particulate marrow and cancellous-bone grafts. However, a large block graft necessitates removal of a large portion of the patient's anatomy and does not provide the high concentration of osteogenic tells the particulate marrow and caneellous-bone graft does. A technique that is commonly used to reconstruct defects of the mandible uses the advantages of both autogenous and allogeneic bone grafts (Fig. 28-2). An allogeneic block graft is obtained in the form of an ilium or mandible. This graft is used for its structural strength and protein, which induces phase II bone formation from the surrounding tissues. This graft is hollowed out until only the conical plates remain.

Autogenous particuiate marrow and cancellous bone is then obtained and packed into the shell to provide the

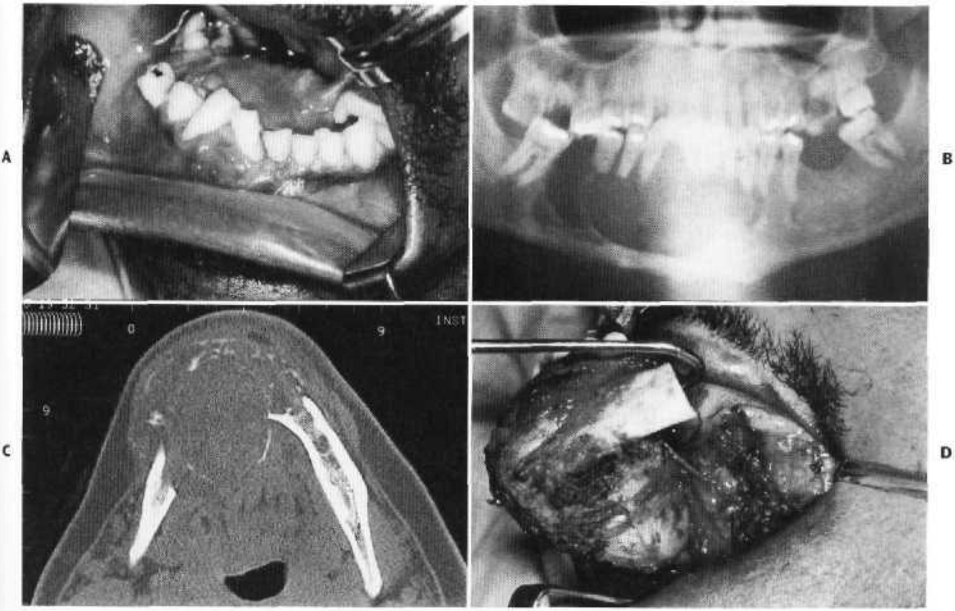

FIG. 28-2 Use of the combination of allogeneic and autogenous bone grafts to reconstruct mandSble after resection for ameloblastoma. A, Large expansile lesion of mandibular body and **symphysfs- B,** Panoramic radiograph of lesfon. C, Axiaf compjted tomogram showing size of lesion. D, Resection of lesion via a transoral approach.

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osteogenic cells necessary for phase I bone formation. In this way the ingredients necessary for both phases of osteogenesis arc provided without necessitating the removal of a large portion of the individual's anatomy. The allogeneic portion of the graft acts as a biodegradable tray, which in **time** is completely replaced by host bone.

Advantages. Advantages of this procedure are the same as those for both autogenous and allogeneic grafts.

Disadvantages. The disadvantage is that this procedure necessitates a second site of operation in the host to obtain autogenous parriculate marrow and cancellous-bone graft.

ASSESSMENT OF PATIENT IN NEED OF RECONSTRUCTION

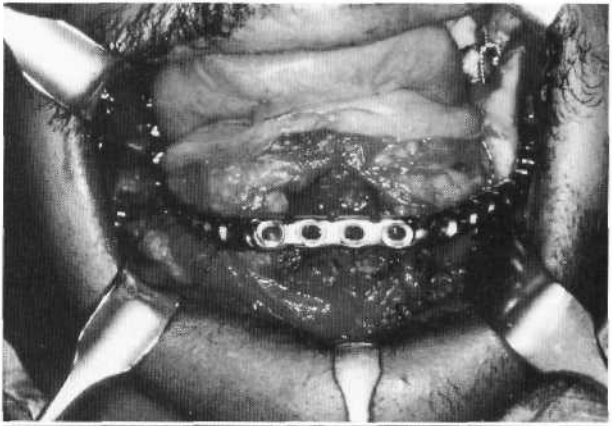
Patients who have defects of the jaws can usually be surgically treated to replace the lost portion. Each patient, however, must be thoroughly evaluated individually, because no two patients have the exact same problems. Analysis of the patient's **problem** must take into consideration the hard tissue defect, any soft tissue defects, and any associated problems that will affect treatment.

Hard Tissue Defect

Several factors concerning the actual **osseous** defect must he thoroughly assessed to help formulate a viable treatment plan. Adequate radiographs are necessary to evaluate the full extent of the osseous defect. The site of the defect may be just as important as the size of the defect when dealing with mandibular osseous problems. For example, if the mandibular condyle is missing, treatment is relatively more difficult. A residuai portion of the ramus with the condyle still attached makes osseous reconstruction easier, because the temporomandibulai articulation is difficult to restore.

The mandible has powerful muscles attached to it that usually direct functional movements- When the continuity of the mandible is broken, these muscles no longer work in harmony and may severely displace mandibular fragments into unnatural positions. Therefore the position of the residual mandibular fragments must be ascertained. For example, if a portion of the mandible in the area of the molars is missing, the muscles of mastication still attached to the mandibular ramus may rotate *the* ramus superiorly and medially, which may allow penetration into the oral cavity and compound the difficulty of planned treatment.

E



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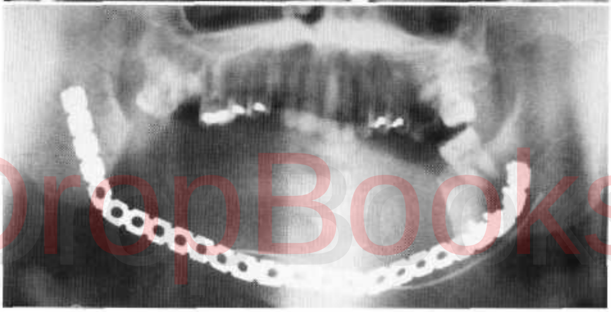

FIG. 28-2—cont'd E, Placement of large metal bone plate lo reconstruct mandible after tumor rejection. The plate is attached to both rami and provides Support to the overlying soft tissues to prevent their contraction during the healing process. The tongue musculature is sutured Lo the hone plate to maintain its forward position, ensuring patency of the airway F, Panoramic frontal radiograph showing bone plate in position.

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Soft Tissue Defect

Proper preparation of the soft (issue bed thai is to receive the bone graft is just as important to the success of bone grafting as the bone graft material itself. The **transplanted** bone cells must survive initially by diffusion of nutrients from the surrounding soft tissues, Revascularization of the bone graft through the development of new blood vessels from the soft tissue bed must then occur. Thus an essential factor for the success of any bone-grafting procedure is the availability of an adequately vascuiarized soft tissue bed. **Fortunately** this essential factor is usually obtainable in the lush vascular tissue of Ihe head and neck region. However, occasionally the soft tissue bed is not as desirable as it could be, such as after radiotherapy or excessive scarring from trauma or infection. Therefore a thorough assessment of the quantity and quality of the surrounding soft tissues is necessary before undertaking bone graft procedures.

The reason for the osseous void often provides important information on the amount and quality of soft tissues remaining. For example, if the patient lost a laige portion of the mandible from a composite resection for a malignancy, the chances are that the patient will have **deficiencies** both in quantity and quality of soft tissues. During the initial surgery, many vital structures were probably removed, and dencrvation of the platysma muscle will result in atrophy of the muscular fibers. An intraoral examination helps the clinician determine how much oral mucosa was removed with the mandibular fragment.

Frequently the tongue or floor of the mouth appears to be sutured to the buccal mucosa, with no intervening alveolar ridge or buccal sulcus, because the gingiva is sacrificed with the osseous specimen.

If the patient received cancericidal doses of radiation to the area of the osseous defect, the clinician can assume

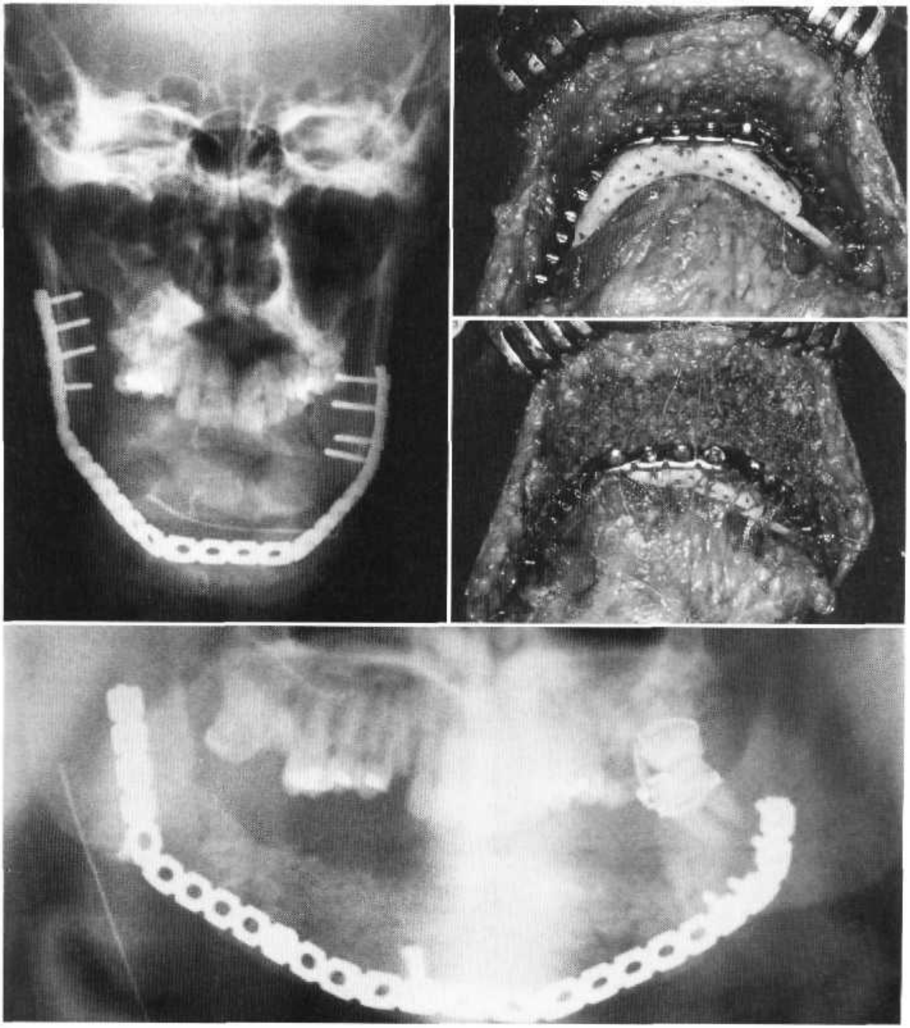

FIG. 28-2—cont'd C, **Full-face** panoramic frontal radiograph. H, After healing ot the intraoral soft tissues, an extraoraf approach is used for bone graft reconstruction. An allogeneic mandible is hollowed out and secured to **the** bone plate with bone screws. Note **the** perforations of the mandible to promote revascularization. I, Particulate marrow and cancellous bone is packed within the allogenic mandible before closure. J, Panoramic radiograph showing bone graft in place. The bone plate is **left** in situ.

that the patient's **soft** tissues have undergone extreme atrophy and scarring and will be **nonpliable** and fragile. The soft tissues in this instance will provide a poor bed for a hone graft, because the environment is hypovascular, hypoxic, and hypo cellular.[1] Similarly if the patient's defect was caused by a severe infection, it is likely that an excess of scar tissue formation occurred, which will result in nonpliable, poorly vaseularized tissue.

After a thorough evaluation, a decision must be made about the adequacy of the soft tissues. If the *quantity* of tissue is deficient, soft tissue flaps from the neck containing muscle and skin can be used to enhance the amount of tissue available to close over the bone graft. If the soft tissues are deficient in *quality,* one of two basic methods can be used to reconstruct a patient's defects: The first is to supply an autogenous bone graft with its own blood supply in the form of a free or pedicled composite graft.

The second, method is to improve the quality of the soft tissues already present by the use of hyperbaric oxygen (HBO). The HBO method improves tissue oxygenation by the administration of oxygen lo the patient under higher-than-normal atmospheric pressures. Tissue oxygenation has been shown to improve to acceptable leveb after 20 HBO treatments."

After HBO treatment, bone-grafting procedures can be performed with good success. Another course of **HBO** treatment is then recommended after the bone-grafting procedure*

Associated Problems

The clinician must always remember that the cure should be less offensive to the patient than the disease process. In other words, if a reconstructive procedure will significantly risk the individual's Life or is associated with a very high incidence of complications that may make life worse for the patient, it would probably be in **the** patient's best interest to forego tine procedure. As with any type of therapy, significant factors must be assessed, such as the patient's age, health, psychologic state, and, most important perhaps the patient's desires. Thorough understanding by the patient of the risks and benefits of any treatment recommendation is imperative so that an informed decision can be made.

GOALS AND PRINCIPLES OF MANDIBULAR RECONSTRUCTION

Marx and Sanders[1] have identified several major goals for mandibular reconstruction that should be strived for and achieved before any grafting procedure can be considered a success.

Restoration of Continuity

Because the mandible is a bone with Iwo articulating ends acted on by muscles with opposing forces, restoration of continuity is the highest priority when reconstructing mandibular defects- Achieving this goal will provide the palicnt with better functional movements and improved facial esthetics by realigning any deviated mandibular segments.

Restoration of Alveolar Bone Height

The functional rehabilitation of the patient rests on the ability to masticate efficiently and comfortably. Prosthetic dental appliances are frequently necessary in patients who have lost a portion of their mandible. To facilitate proslhetic appliance usage, an adequate alveolar process must be provided during the reconstructive surgery. The ideal ridge form outlined in Chapter 13 for the edentulous patient applies equally to patients undergoing mandibular reconstructive surgery.

Restoration of Osseous Bulk

Any bone-grafting procedure must provide enough osseous tissue to withstand normal function. If too thin an osseous strut is provided, fracture of the grafted area may occur.

SURGICAL PRINCIPLES OF MAXILLOFACIAL BONE-CRAFTING PROCEDURES

Several important principles should be followed during any grafting procedure. They must be strictly adhered to if a successful outcome is desired. The following are a few that pertain to reconstructing rnandibular defects:

1. *Control of residual mandibutar segments.* When a continuity defect is present, the muscles of mastication attached to the residual mandibular fragments will distract them in different directions unless efforts were made to stabilize the remaining mandible in its normal position at the time of partial resection. Maintaining relationships of the remaining mandible fragments after resection of portions of the mandible is a key principle of **mandibular** reconstruction. This is important for both occlusal and temporomandibular joint flMJl positioning. When the residual fragments are left to drift, significant facial distortions can occur from deviation of the residua] mandibular fragments (Fig. 28-3), **Metal** bone plates inserted at the time of resection are useful for controlling the position of the mandibular fragments (see Fig. **28-2,** *E).* They are of sufficient strength to obviate the need for maxillomandibular fixation, permitting active use of the mandible in the immediate postoperative period. In older individuals or those with significant medical compromise, this may be the final form of reconstruction. It provides soft tissue support to maintain facial symmetry. When the mandibular symphysis has been removed, the tongue can be sutured to the plate, maintaining its forward position to prevent airway obstruction (see Fig. 28-2, £). The bone plate can be left in place when the mandible is secondarily reconstructed with bone grafts, permitting mobility of the mandible during the bone graft's healing phase (see Fig. 28-2, /).

FIG. 28-3 Patient whose left mandibular ramus and posterior body was removed 10 years previously for malignant disease (A). The deviation of the chin to the lefl side *k* visualized. Postsurgical radiotherapy was also used during therapy. The patient underwent hyperbaric oxygen treatments before bone graft reconstruction. B, Panoramic radiograph showing residual mandible.

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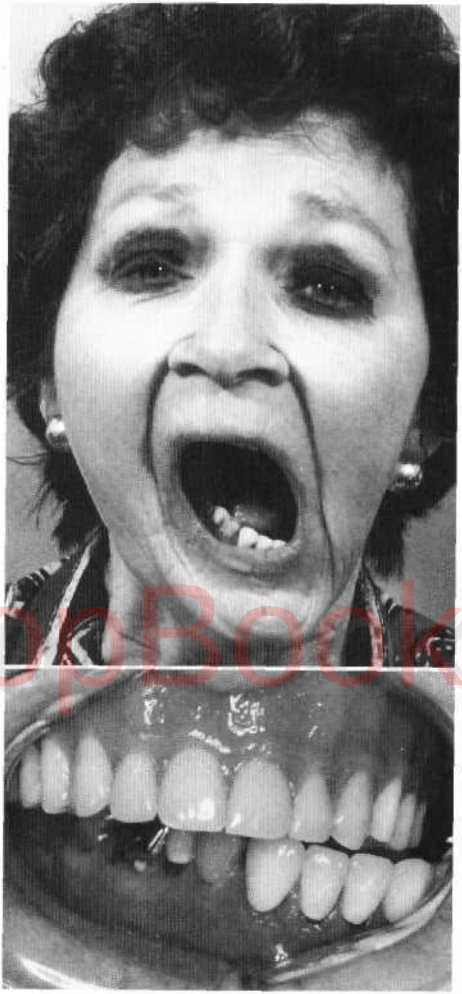

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FIG. 28-3—contd C, Maximum opening of mouth shows gross. deviation to resected **side. D,** Intraoral photograph showing the cross-bite relationship from the deviation of the mandible to the left side.

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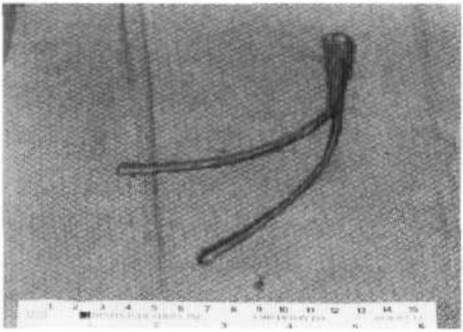
E



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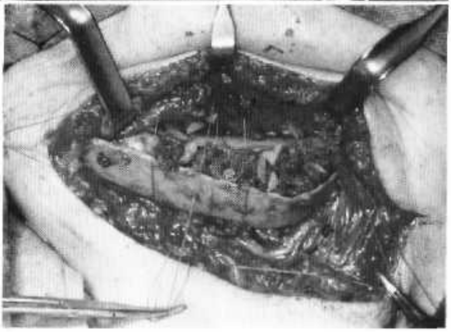

FIG. 28-3—eont'd E, Splitting of the bony rib portion of a costochondral grafts leaving the cartilaginous tip to function as a mandibular condyle. F, During surgery the maxiflary denture is wired to the midfate and maxillomandibular fixation is used to hold the mandible into its proper position. C, Craft placed so that castochondral portion is in mandibular fossa and bony ends are secured to residual mandibular fragments. Iliac cresl bone chips are then packed into the void between the two portions of the rib.

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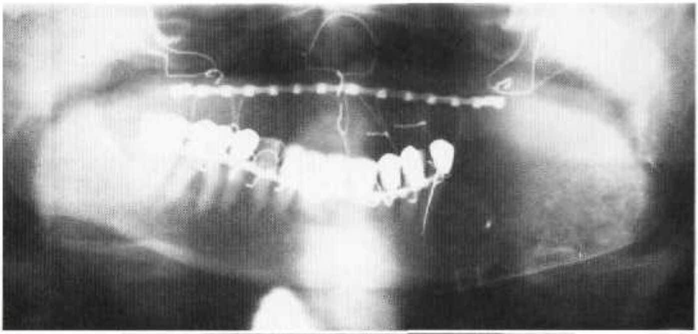
When the position of the residual mandibular fragments have not been maintained during the resection, realignment is more difficult during the reconstructive surgery. Over time the muscles of mastication become atrophic, fibrotic, and nonpliable, which makes realignment of the fragments extremely difficult. During the reconstructive surgery, it may be necessary to strip several muscles off the mandibular fragments to release the bone from their adverse **pull.** A coronoidectomy is usually performed to remove the superior pull of the temporalis muscle. Before inserting a bone graft, the clinician must be sure to reach the desired position of the remaining mandibular fragments, because what is achieved at surgery is whal the patient must live with in the future.

If the mandibular condyle has been resected or is unusable, reconstruction of the condyle with a coslochondral junction of a rib or alloplastic condyle is necessary to maintain the forward position of the reconstructed mandible (see Fig. 28-3).

2. *A good soft tissue bed for the bone graft.* All hone grafts must be covered on all sides by soft tissues to avoid contamination of the hone graft and to provide the vascularity necessary for rcvascularization of the graft. Areas of dense scar should be excised until healthy tissue is encountered. Incisions should be designed so that when the wound is closed, the incision will not be over the graft, which means that the Initial incision may be very low in the neck (see Fig. 28-3, *G).* A multilayered soft tissue closure is performed to reduce any space that might allow collection of blood or serum and to provide a watertight closure.

A, *Immobilization of the graft.* Immobilization of bone is necessary for osseous healing to progress, which is why orthopedic surgeons apply a cast to a fractured extremity. In dealing with mandibular defects, the graft must be secured to remaining mandibular fragments, and these fragments must be rigidly immobilized to ensure that no movement exists between them. This immobilization is most often provided by the use of intermaxillary fixation, in which the mandible is secured to the maxilla (see Fig. 28-3). However, several other methods are **possible,** such as using a bone plate between the residual bone fragments (see Fig. 28-2). Immobilization for 8 to 12 weeks is usually necessary for adequate healing between the graft and the residual mandibular fragments.

H



I

FIG. 28-3—cont'd **H,** Immediate postoperation radiograph demonstrates the graft in place. **I, Patient** 8 **months** after surgery. The chin is now in ihe midline.

4. *Aseptic environment.* liven when **transplanting** autogenous osseous tissue, the bone **graft** is **basically avascular,** which means **that** the graft has no way of **fighting** any amount of infection. Therefore a certain percentage **of** bone grafts become infected and must be removed. Several measures can be taken to improve the success of bone-grafting procedures. The first is to use an extxaoral incision where **possible.** The skin is much easier to cleanse and disinfect than is the oral **cavity, Bone grafts** inserted through the mouth are exposed to the oral flora during the grafting procedure.

Furthermore the intraoral incision may dehiesce and again expose the bone graft to the oral flora. Bone grafts placed through a skin incision are more success-

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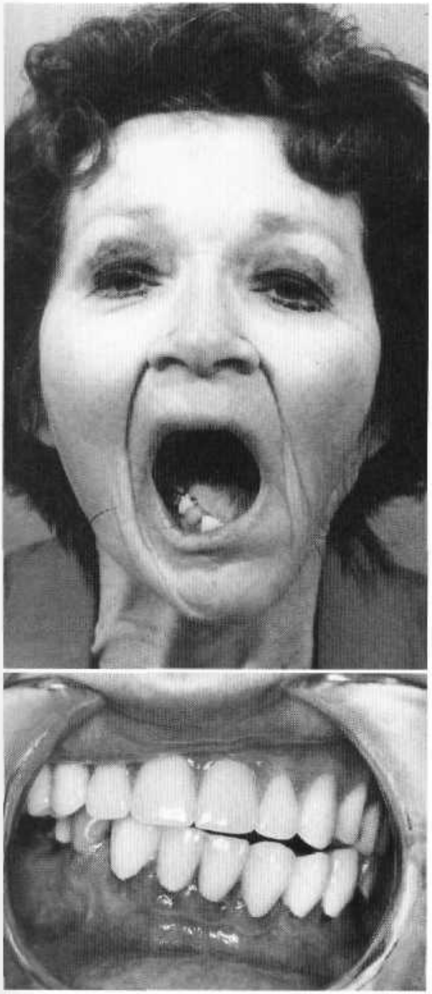

FIG. 28-3—Cont'd I, Patient still deviates to the left on opening because of lack of condylar translation secondary Lo the missing lateral pterygoid muscle. However the chin is not as deviated on wide opening as before surgery. K, Ocdusal result before fabrication of a new denture.

nil than those inserted transorally. However, it is important that during ihc extraoral dissection the oral cavity is not inadvertently entered, ideally dissection to the level of the oral mucosa without perforation is preferred.

5. *Systemic antibiosis.* The use of prophylactic antibiotics may be indicated when transplanting osseous tissue. 'I heir use may be beneficial in helping reduce the incidence of infection (see Chapter 15).

Because of the many muscles attaching to and providing mobility to the mandible, it is the facial bone that is the most difficult to reconstruct. Other facial bones are reconstructed on similar principles.

REFERENCES

1. Marx RE, Saunders TR: Reconstruction and rehabilitation of cancer patients. In Fonseca RJ, Davis WH, editors: *Reconstructive preprosttietic oral and tnaxiiSofaciai surgery,* Philadelphia, 1986, WB Saunders.
2. Axhausen W: The osteogenetic phases of regeneration of bone: a historical and experimental study, / *Bone Joint Surg* 38A:593, 1956.
3. Burwell RG: Studies in the transplantation of bone: the fresh composite homograft-antograft of cancellous bone, / *Bone joint Surg 461&110,* 1964,
4. Elves MW: Newer knowledge of immunology of bone and cartilage, *CHnOrthvp*]20:232, 1976,
5. Gray jC, Elves M: Early osteogenesis in compact *bant, Calcif Hssue hit 29:225,* 1979.
6. Urist MR: Osteoinduction in undermineraMzed bone implants modified by chemical inhibitors of endogenous matrix enzymes, *Clin Qrthap* 78:132, 1972.
7. Urist MR: The substratum for bone morphogenesis, *Dev Biol* 4{suppl):125, 1970.
8. Marx RE, Ames |R: *The* use of hyperbaiic oxygen therapy in bony reconstruction of the irradiated and tissue-deficient patient, / *Oral Maxillofac Surg* 40:412, 19K2.